PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
CRF PA0215WO		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DK 03/00804	24.11.2003	23.11.2002
International Patent Classification (IPC) or both national classification and IPC		
G02B6/16		
Applicant		
CRYSTAL FIBRE A/S et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20.04.2004	28.02.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Yenidunya, R Telephone No. +49 89 2399-6083

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/DK 03/00804

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-57 as originally filed

Claims, Numbers

1-29 filed with telefax on 07.10.2004

Drawings, Sheets

1-19 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

   ☐ restricted the claims.

   ☐ paid additional fees.

   ☐ paid additional fees under protest.

   ☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

   ☒ all parts.

   ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-9,11,14,16-29
	No:	Claims	10,12,13,15
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-9,11,14,16-29
Industrial applicability (IA)	Yes:	Claims	1-29
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item IV

The present application lacks unity for following reasons:
Claims 1-8 are directed to a coupling method of a fiber claimed in claim 10.
Claims 9 and 29 are directed to an article comprising a fiber connected to an article using the method claimed in claims 1-8.
Claims 10-12, 13-23 and 28 are related to a **known** fiber as discussed below.
Claims 24-25 are related to the preform to produce the fiber as claimed in claims 10-23.
Claims 26-27 is the related to the production method of the fiber.
The common concept among these groups of claims is a photonic crystal fiber having also voids on the outer cladding, which is known as will be explained below.
Since, the common inventive concept among these claims is known and the remaining features are related to different technical problems, the current applicant lacks unity (Rule 13.1 PCT).

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following document, cited in international search report.

D1: WO00/49435

The documents D2 - D4 were not cited in the international search report.

D2: Cladding pumped Ytterbium-doped fiber laser with holey inner and outer cladding, Optics Express, Vol.9, No:13, pp.714-720, Furusawa,K. et. al.

D3: Photonic Band Gap Guidance in Optical Fibers , Science Vol.282, Issue 5393, pp 1476-1478, 20.Nov.1998,Knight,C.J.

D4: US2002/0061176 A1

[lack of novelty]
The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 10,12, 13,14,15 is not new in the sense of Article 33(2) PCT.

The document **D2** discloses (the references in parentheses applying to this document):
A silica based (p.715, lines 37-41) optical fiber (Fig.2) comprising
a: a core region
b1: a microstructured cladding region surrounding the core region, wherein the cladding region comprises a background material with a refractive index n_1, comprising thermally collapsible holes.
b2: an outer cladding region with a refractive index n_2, wherein the outer cladding also comprises thermally collapsable holes or voids having a diameter d_2 and n_1 is larger than n_2 (Fig.1). **The relationship between n_2 and n_1 can be easily recognized in Fig.2. As can be seen in Fig.2, the fraction of holes to the material in the outer cladding is higher (lower refractive index) than the fraction of holes tothe material in the inner cladding (higher refractive index), which implicitly means n_1 is larger than n_2.**

Therefore the subject matter of claims **10,12,13,15** is not new.

[lack of inventive step]
The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims **1-9,11,14,16-19,20, 21, 22,23-26,27-29** does not involve an inventive step in the sense of Article 33(3) PCT.

D1 discloses a photonic crystal fiber, having thermally collapsable holes and voids in the cladding region, but it does not discloses an outer cladding (i.e Fig.3).

D1 teaches , that during fusion splicing of two photonic crystal fibers the air inside would expand explosively and destroy the fiber ends being joined (p.3, lines 18-20)
D1 also teaches a method to splice such a fiber, **without having the explosively expansion of air in the holes** wherein existing holes or voids are partially or completely collapsed in the heat treated region (p.4, lines 3- 27) and spliced together with fusion splicer (p.6, line 19).
To avoid explosion of holes, D1 discloses a heat treatment (p.3, line 24, p.4, line 27)

any time after fabrication.
Despite, the fiber disclosed in D2 has an outer cladding with holes in contrary to the fiber disclosed in D1, the skilled person would be aware of the expansion of the air in the holes of the outer cladding of the fiber and would thermally collapse them, when he wants to splice such a fiber and any other optical device together (p.6, lines 8- 25).
and would apply the method disclosed in D1 to splice such fibers.
Therefore, the subject-matter of claims **1-9,11** does not involve an inventive step in the sense of Article 33(3) PCT.

Claims **14,16-19** are various combinations of the refractive indices at core, first and second claddings. D1 (Fig.6), D2 (Fig.2), D3 (Fig.3 and 4) and D4 (Fig:2,3,8,9,10) disclose also various combinations. Therefore the skilled person would choose a suitable combination among the various possibilities without using inventive skills.

Claims **20,22-23** specify dimensions of the core and cladding. The skilled person would select suitable dimensions depending on the wavelength, power and environmental conditions.
Therefore, the subject-matter of claims **20,22-23** does not involve an inventive step in the sense of Article 33(3) PCT.

Claim **21** specifies operating wavelength, which is widely used in the art.
Therefore, the subject-matter of claim **21** does not involve an inventive step in the sense of Article 33(3) PCT.

Since the fiber having voids in the outer cladding is known from D2
and the production method of a fiber without an outer cladding both with holes in the cladding is known, the skilled person would modify this method to produce the fiber disclosed in D2. Therefore the subject matter of claims **24-26** does not involve an inventive step in the sense of Article 33(3) PCT.

Claims **27-29** describe products obtained using the fiber disclosed in D2.
Therefore, the subject-matter of **claims 27-29** does not involve an inventive step in the sense of Article 33(3) PCT.

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 andD2 are not mentioned in the description, nor are these documents identified therein.